

Nuance Event Generator in LArSoft

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- A new Module has been added to the svn repository that reads in the Events Generated by NUANCE and pass the primary particles to LArG4, DriftElectrons and DetSim
 - NUANCEGen.cxx
 - NUANCEGen.h
 - prodnuance.fcl
 - nuance.fcl
 - NUANCEGen_module.cc
- **Input:** Nuance Event File (txt) (Generated by Josh – THANKS)
 /argoneut/app/users/saima/NuanceFiles/
- **Output:** simb::MCTruth
- The module is currently specific for NUANCE CCQE Cabibbo Suppressed reaction channel (#95) (can be modified for other channels as well)

$$1) \bar{\nu}_{\mu} p \rightarrow \mu^+ \Lambda^0$$

$$2) \bar{\nu}_{\mu} n \rightarrow \mu^+ \Sigma^-$$

$$3) \bar{\nu}_{\mu} p \rightarrow \mu^+ \Sigma^0$$

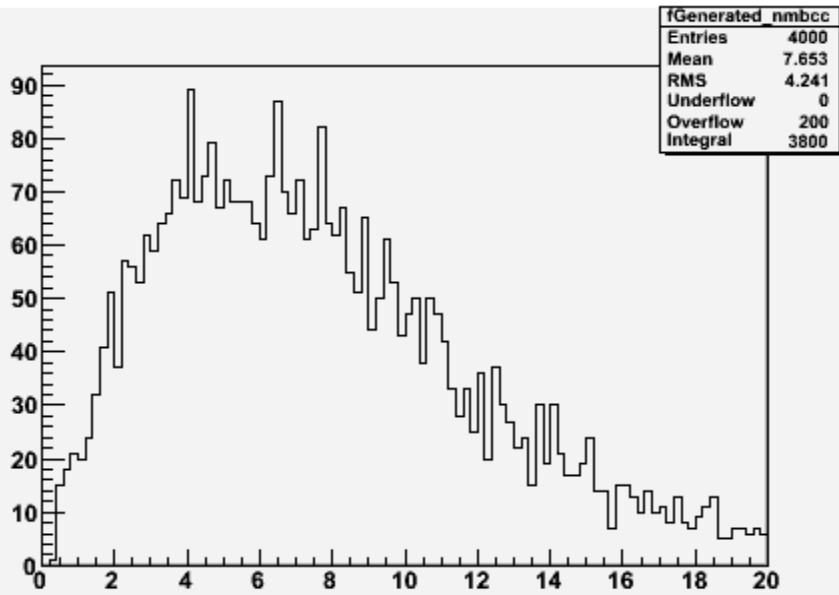
Filling the Truth Information

- Simb::MCParticle
 - TrackId = -1
 - PdgCode
 - Primary
 - First Mother = -1
 - Mass
 - StatusCode = 0 for initial state, 1 for final state particle
- AddTrajectoryPoint (position, momentum)
 - Vertex position is transformed from Nuance coordinate system (origin at the 3D center of detector) to coordinate system used by the EventGenerator
 - 4-Momentum of the particle is calculated using the 'direction cosines' and the 'energy' given by the Nuance
 - Target 4-Momentum is calculated by using the conservation of 4momentum in the interaction

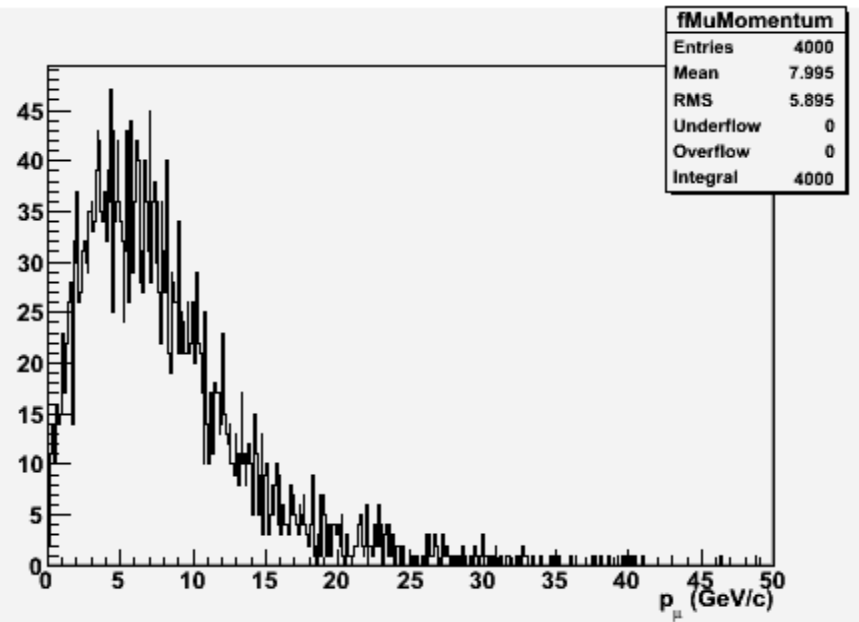
Filling the Truth Information

- Simb::MCTruth
 - SetNeutrino (
 - **CCNC** = 0 if there is a charged lepton in final state, otherwise 1
 - **Mode** = 0 for QE (hard coded for now... B. Rebel will give enumerated list with Nuance codes)
 - **Target** = -9999
 - **HitNuc**
 - **HitQuark** = -9999
 - **W**
 - **X** = $Q^2/2P.q$, where $q^2 = (k-k')^2$ and P is target 4-momentum
 - **Y** = $P.q/k.P$
 - **QSqr** = $-q^2$)

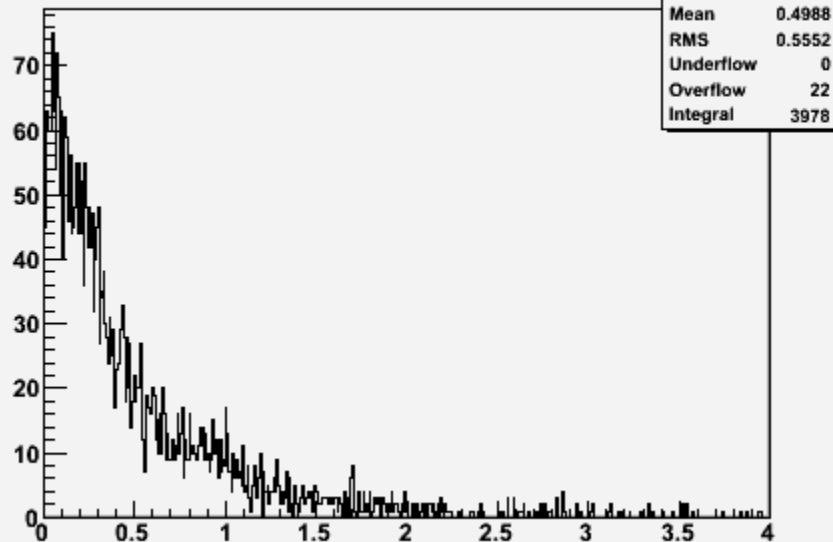
AntiNeutrino Energy (GeV)



Muon Momentum (GeV/c)

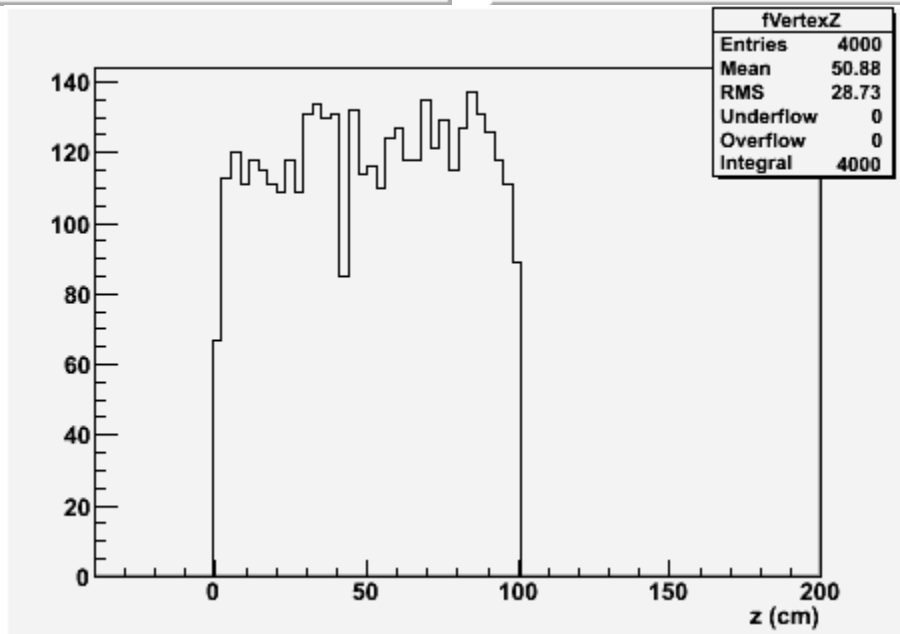
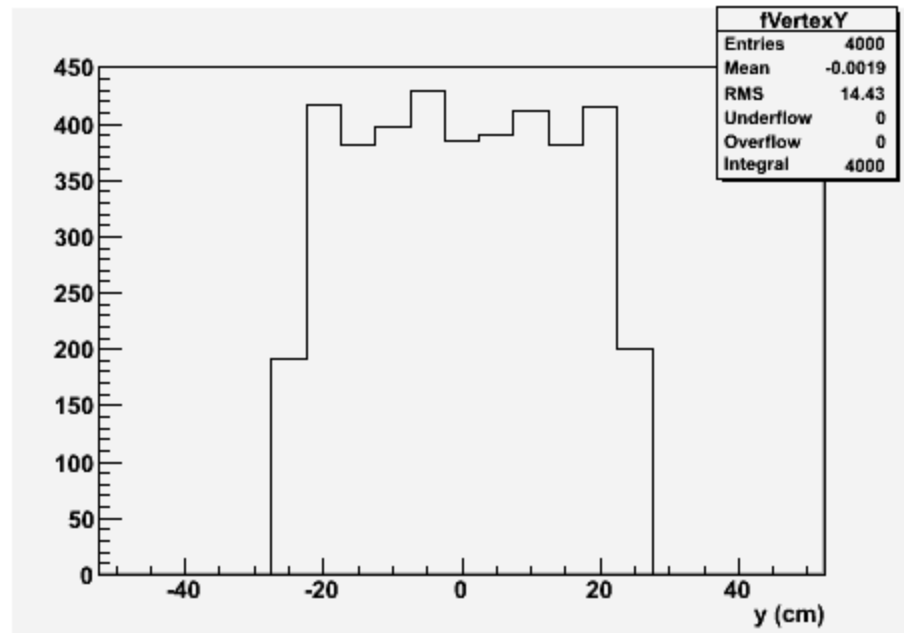
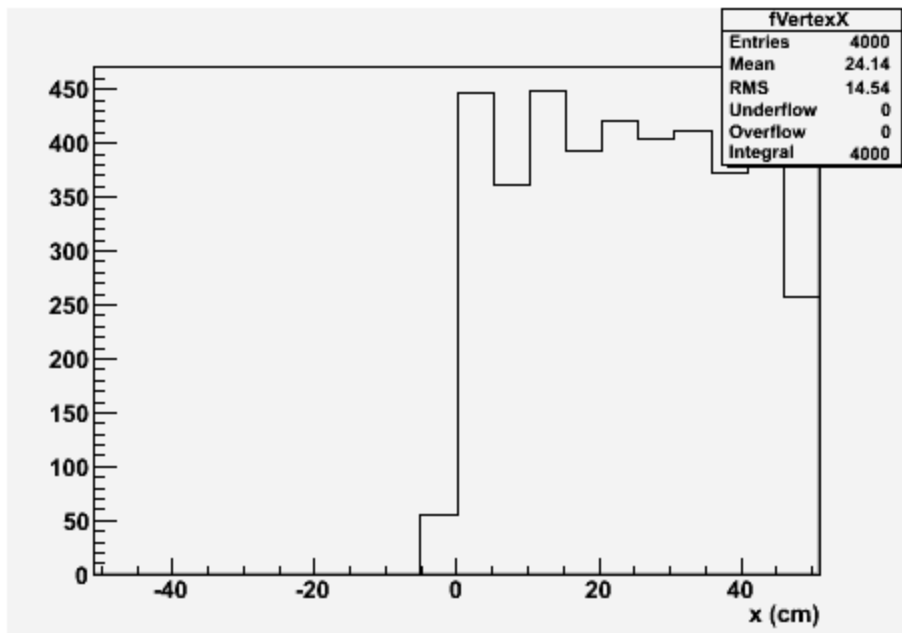


Q^2 (Gev^2)



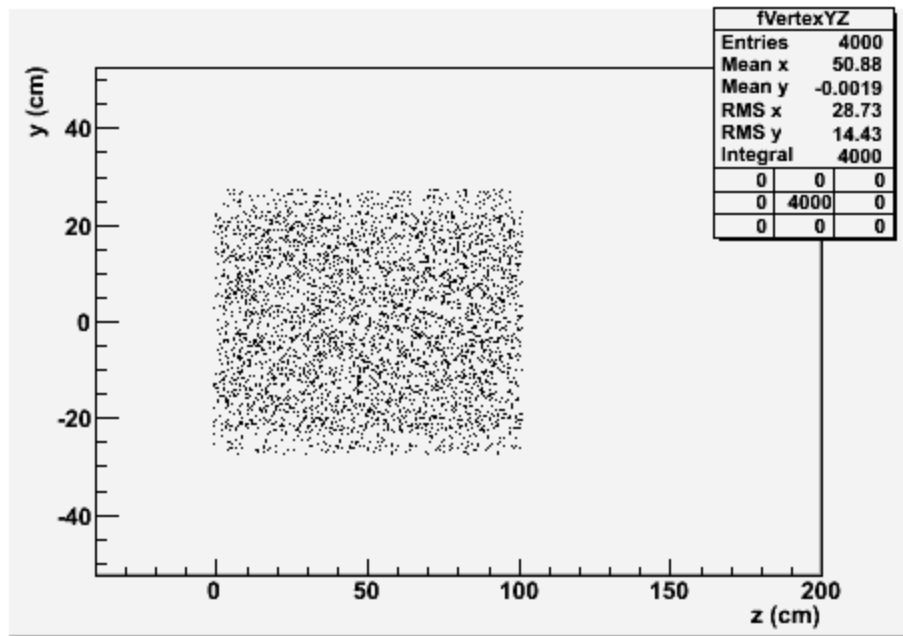
Momentum Transfer Q^2 (GeV²)

Vertex X, Y and Z

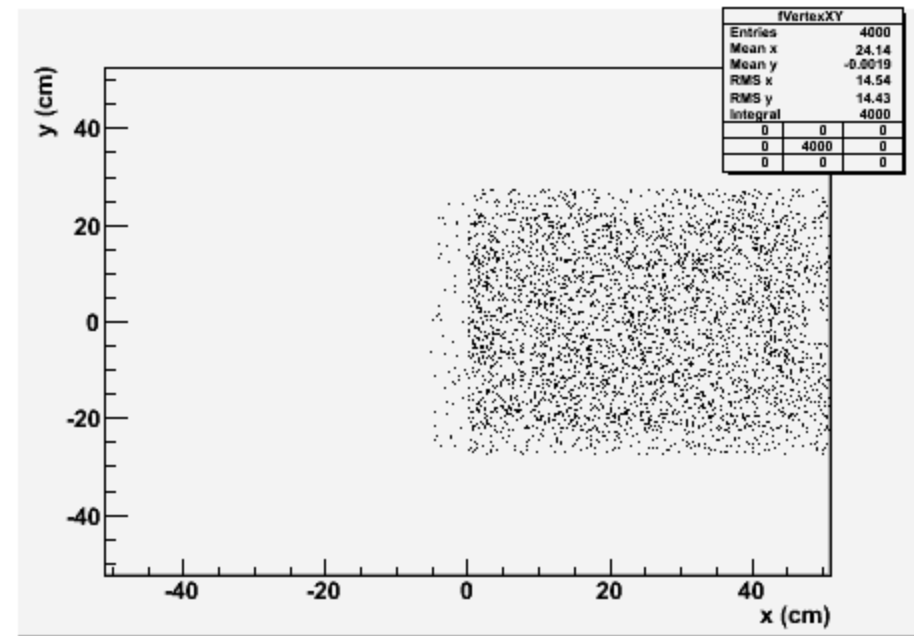


Vertex Position 2D view

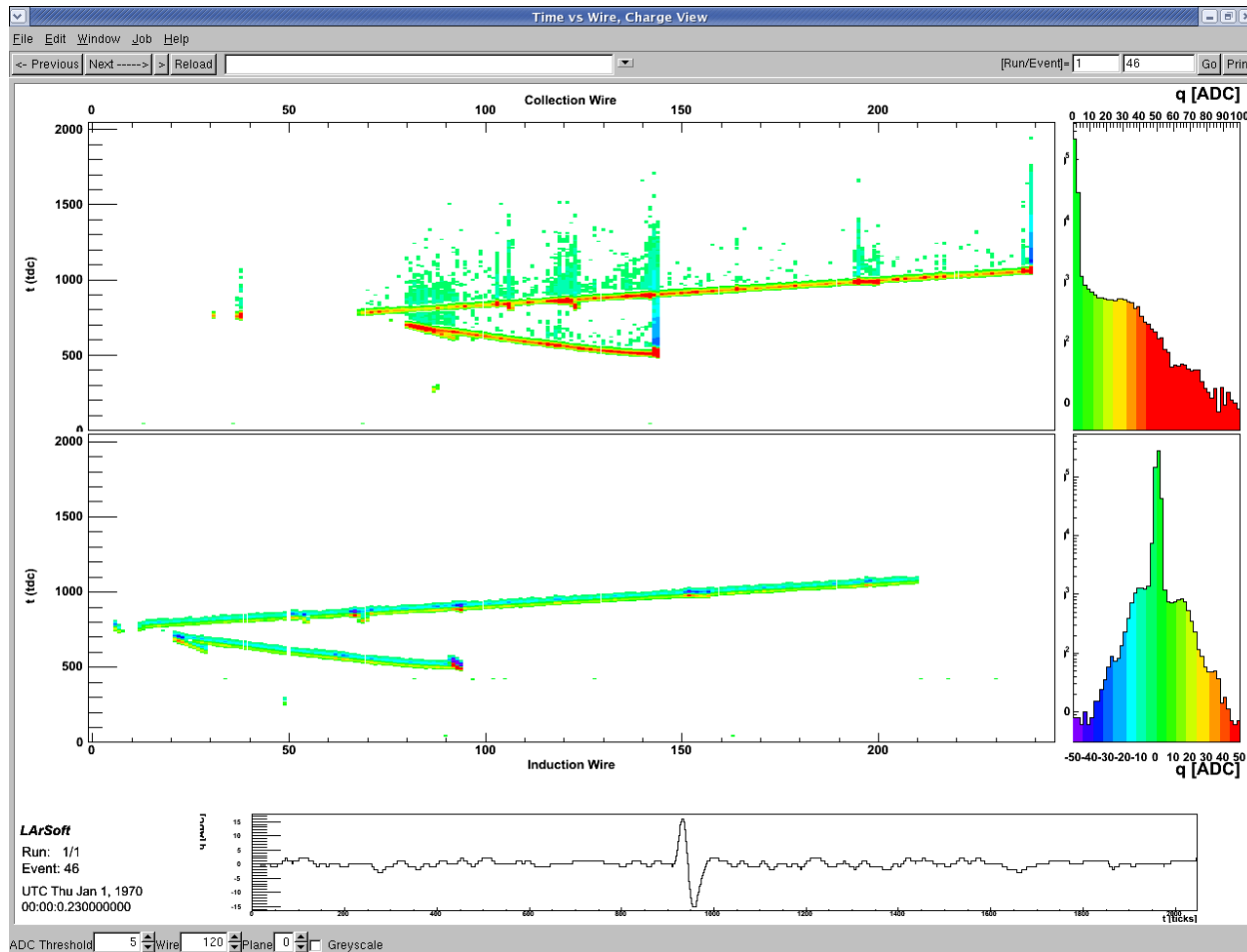
Side View (YZ plane)



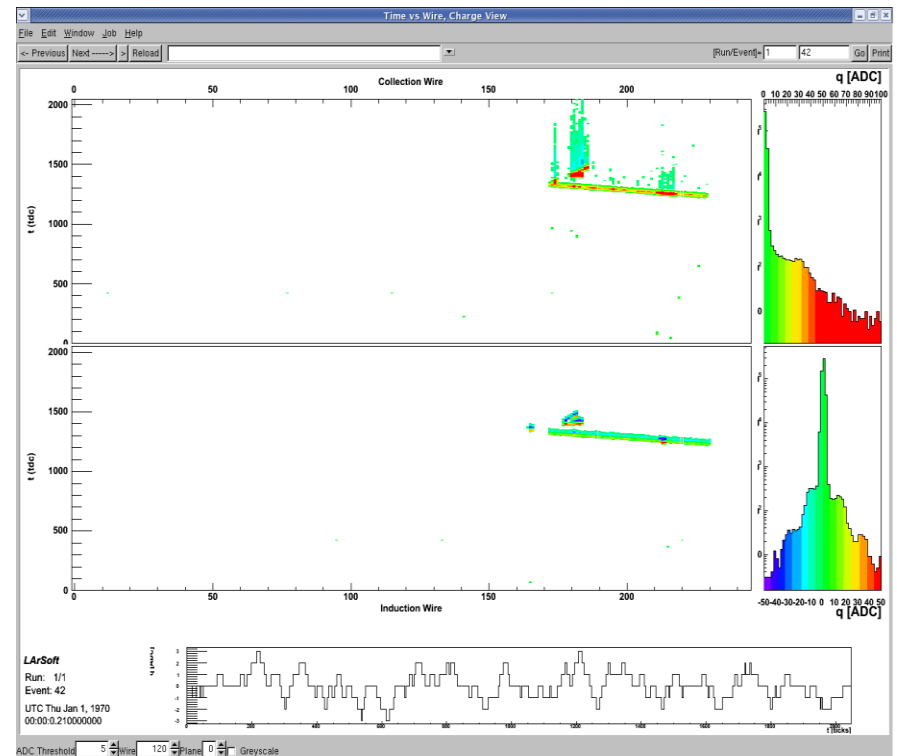
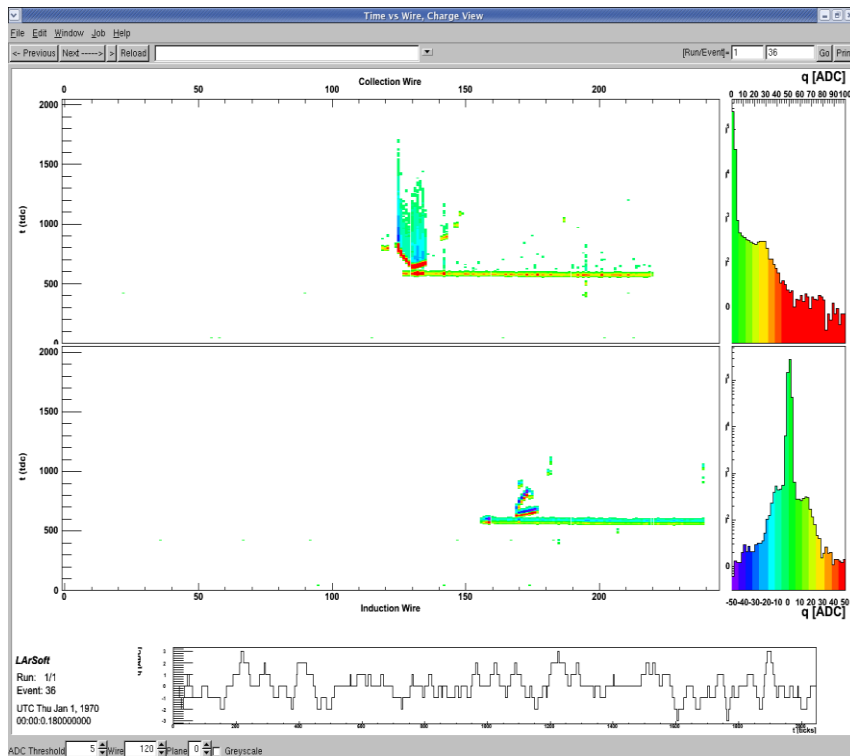
Front View (XY plane)



CCQE Hyperon Production from Nuance



CCQE Hyperon Production from Nuance



Thanks

Specially to Brian, Sam Zeller and
Josh